

# Power Efficiency Enhancement and Radiation Reduction for WLAN by using Directional Antenna

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**Abstract:** In the development of wireless technologies, it is important for healthcare organizations to reduce risks to patients from use of wireless devices. Radio Frequency (RF) seriously effects on human health specially use of cell phones, mobile radios, microwave radios, microwave ovens, broadcast radio and television transmitters, power lines and X-rays. In recent times, many people have expressed an interest in learning if the use of cell phones is associated with cancer. Many have heard or read about possible links between cell phones and cancer, but conclusions are rarely definitive. We can reduce the effect of radiation by using directional antenna in the network. This paper tries to show the effects of electromagnetic radiation on human body how the directional antenna reduces the effect of directional antenna.

**Keywords:** Directional antenna, EMR, Health risk, ionizing radiation, non-ionizing radiation, Omni-directional antenna.

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## Introduction

Wireless communication links have been used worldwide for many years as solutions for connectivity in point-to-point and point-to-multi-point applications. The most common wireless solutions include AM and FM radio, television broadcast stations, mobile and cellular phones, radar and microwave systems[1].

The electromagnetic (EM) spectrum contains an array of electromagnetic waves increasing in frequency from Extremely Low Frequency and Very Low Frequency (ELF/VLF), through Radio Frequency (RF) and Microwaves, to Infrared (IR) light, Visible Light, Ultraviolet (UV) light, X-rays, and Gamma rays.

The higher part of the frequency is called Ionizing radiation and the lower part of the frequency is non-ionizing radiation. Ionizing radiation contains sufficient electromagnetic energy to strip atoms and molecules from the tissue and alter chemical reactions in the body (converting molecules totally or partly into ions). Non-ionizing Electromagnetic Radiation (EMR), with energy levels below that required for effects at the atomic level.

Some studies suggest that potential health hazards could be linked to excessive exposure to high-power densities of non-ionizing radiation. These health hazards include: Cancer, Tumours, Headaches, Fatigue, Alzheimer's Disease, Parkinson's Disease etc. [1].

Now a day, the wireless devices use omni directional antenna, which radiates signals omni directional. So, when we use the device it affects the environment around the devices. However, when the devices are mounted with directional antenna, it radiates

signals in a particular direction. So the other direction of the devices is not affected due to the radiation. This way we can reduce the electromagnetic radiation by using the directional antenna.

### A. Electromagnetic Radiation

Electromagnetic radiation can be classified into two types: ionizing radiation and non-ionizing radiation, based on its capability of ionizing atoms and breaking chemical bonds[2].

Figure 1 shows the Electromagnetic Radiation (EMR) on the basis of frequency. **Ionizing radiation** is the process of converting an atom or molecule into an ion by adding or removing charged particles such as electrons or ions [3]. Ultraviolet and higher frequencies, such as X-rays or gamma rays, **Non-ionizing radiation** refers to any type of electromagnetic radiation that does not carry enough energy per quantum to ionize atoms or molecules — that is, to

completely remove an electron from an atom or molecule[3]. The radiation with particle of photon energies less than 10 electron volts (eV) be considered non-ionizing.

In this paper we are discussing only effects of non- ionizing radiation and its effects on human bodies.

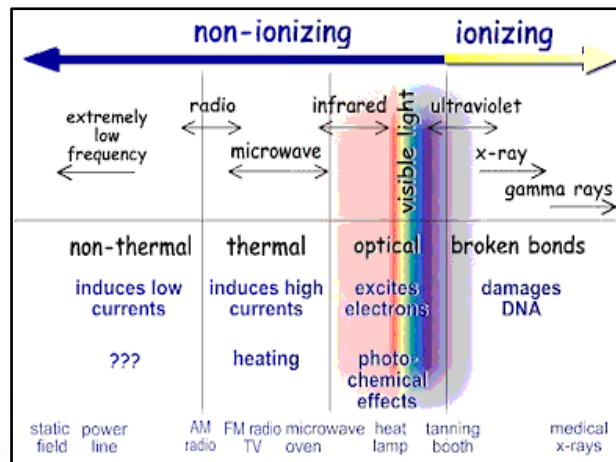


Figure 1. Electromagnetic Radiation

Examples of non-ionizing radiations are:

- Static electromagnetic fields from direct current (0 Hz)
- Low-frequency waves from electric power (50-60 Hz)
- Extremely Low Frequency (ELF) and Very Low Frequency (VLF) fields (up to 30 kHz)
- Radio Frequencies (RF), including Low Frequency (LF), Medium Frequency (MF) High Frequency (HF), Very High Frequency (VHF), Ultra High Frequency (UHF) and Microwave (MW) and Millimetrowave (30 kHz to 300 GHz)
- Infrared (IR) light, Visible light and Ultraviolet (UV) light (above 300 GHz).

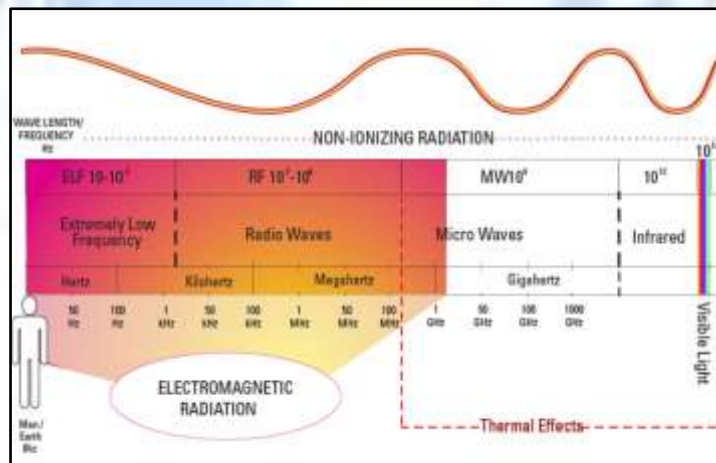


Figure 2: shows the non-ionizing electromagnetic radiation and its frequency

### B. Effects of Electromagnetic Radiation

Science shows that many processes of the human body are regulated with bioelectrical signals[2], [4], [5]. Strong, artificial EMFs can enter our body interfere with all that, (magnetic fields can even pass into our body and induce current) harming everything from our sleep cycles and stress levels to our immunities and DNA. Concern about EMFs has been around a long time. Farmers with sick and dying cattle herds living under high power transmission lines were among the first to sound the alarms. Decades of research and epidemiological studies conducted all over the world have shown the dangers of the EMFs we live with every day.

### C. Electromagnetic radiation health risk

Some heating effect is produced through all of these waves. Unsatisfactory energy is obtainable from most common sources to produce any type of harm to human tissue, although it is likely that higher power densities, such as those densities very near high-voltage power lines or high-power (megawatt) broadcast transmitters, could have long-term health effects. The power density of any source of EMR is not only related to the power level at the source, but increases rapidly as the distance from the source decreases. A common concern today, since more and more people are using cell phones than ever before, is that cell phone antennas radiate near a person's head. Cell phones, however, radiate very little power. So, even while close to the head, they are not considered a danger. Some studies suggest that potential health hazards could be linked to excessive exposure to high-power densities of non-ionizing radiation. These health hazards include: Cancer, Tumours, Headaches, Fatigue, Alzheimer's Disease, Parkinson's Disease[4]–[8].

Approximately 20-80% of the device radiation from the device's antenna penetrates up to 2 inches into the adult brain and more into child brain. Anytime the power is turned on, the devices emit electromagnetic radiation – even in stand-by mode, expose other areas of the body to harmful ELF radiation. Some of the potential side effects of exposure to electromagnetic radiation such as- Blurry vision, Headaches, Nausea, Fatigue, Neck pain, Memory loss, Leukaemia, Brain cancer etc. Figure 3 shows the some diseases appear due to EMR[1], [4]–[8].

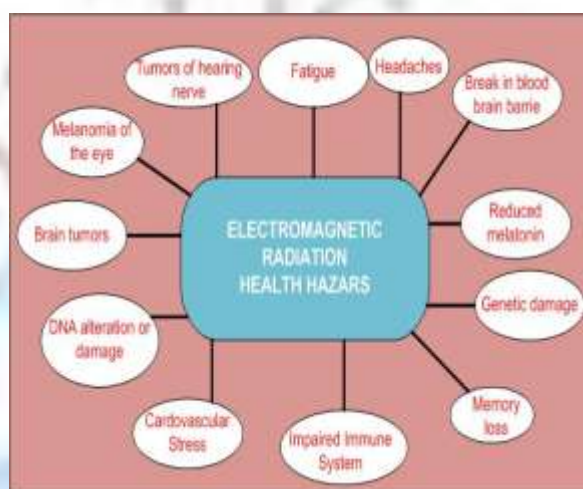


Figure 3. EMR Health Hazards

### D. Existing transmitting and receiving devices

Since, the existing receiving and transmitting devices equipped with omni-directional antenna. Therefore, the devices transmits signals in omni-directional. When two devices are communicating, the neighbour of the devices unnecessarily suffers from the radiation generated by those devices. Therefore, the EMR affects the surrounding area of the transmitter. Existing devices equipped with omni directional Antenna[7].

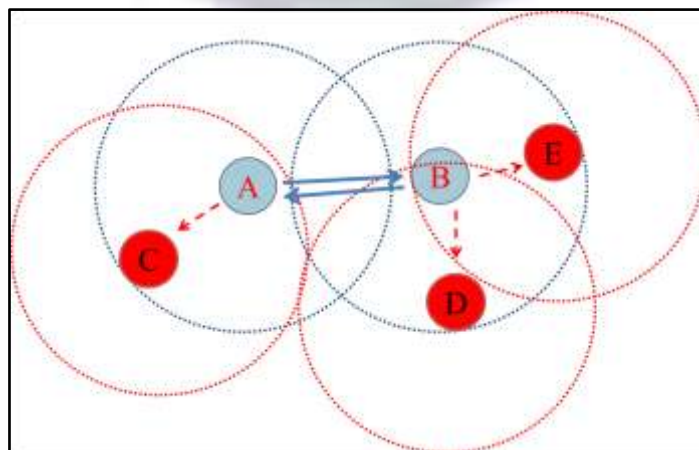


Figure 4: Effects on neighbor with Omni-directional transmission

Figure 4 shows the effects on neighbor with omni-directional transmission in the network. In the figure node A and B are communicating. Since the node A and B are equipped with omni-directional antenna, so it transmits the signal omni-directional. Whereas, they need to transmit signal only towards each other. However, there omni-directional transmission, unnecessary effects the node C, D and E.

#### **E. Directional antenna reduces the effect of EMR**

Directional antenna radiates the signal in a particular direction. With directional antenna we can give direction to the signal. Thus, we can reduce the effect of EMR in network by using the directional antenna. The neighboring devices are not affected due to the directional transmission/reception. Moreover, we can increase the spatial reuse i.e. more than one communication possible at a time in network.

Figure 5 shows the effect of using directional antenna in the network. The scenario of the figure is same as

Figure 4. In the figure, the devices are equipped with directional antenna and the node pair AB and DE are communicating at a same time. Since, their transmission is directional, so they are not effects the other neighbors like node C. Moreover, we get more overall network performance, due to spatial reuse in the network.

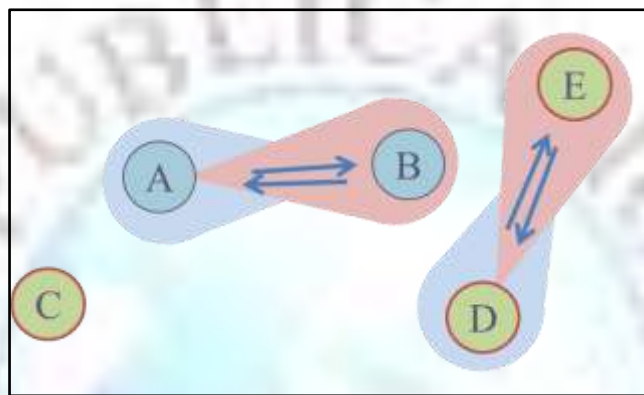


Figure 5: Effects of using directional antenna in network

In directional antenna the gain of an antenna in a particular direction. Therefore the relative power in one direction compared to an omni-directional antenna. Beamwidth (width of a beam) and gain is the inversely proportional i.e. the higher gain and the smaller beam[9].

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#### **Conclusion**

In this paper we presented ionizing and non-ionizing EMR and effects on health. There are several diseases caused by EMR. The EMR propagates by the electronic devices. Now a days main source of propagating EMR is our mobile devices and other wireless communication systems. The existing wireless communication devices uses omni-directional antenna to transmit signals. The omni-directional transmission of signals affects the whole area around the devices, whereas, it need to in a particular direction. In this paper we proposed the use of directional antenna instead of omni-directional antenna with communicating devices. This way we can drastically reduce the EMR propagation in the network. Moreover, we increase network performance due to spatial reuse in the network.

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